

EPIDEMIOLOGY OF SMALLPOX IN WEST AND CENTRAL AFRICA

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TEMPORAL OCCURRENCE

The seasonal pattern of smallpox in West Africa consists of a marked increase in cases from most countries during the dry season, and a decline with the onset of the rainy season. However, some countries, particularly coastal countries, do not show this pattern and some record as many or more cases during the rainy season. Generally, however, smallpox can be characterized as a dry season disease in West Africa.

Superimposed on the seasonal pattern of incidence is a long term cycle with epidemics every four to seven years. Figure 1 shows in dotted lines the average number of reported cases by month between 1960 and 1967. Reports for 1968 are far below the average of the previous seven years, and in early 1969 the expected seasonal rise has not materialized. One must ask whether this might reflect a longer term trend, with 1969 representing a low year which happened to coincide with the completion of the initial mass vaccination programme. However, even if compared with previous low years, the 1969 figures are still extraordinary. For instance, in Nigeria, the lowest previous year was 1964, but cases recorded during 1969 are 84% lower than this. Other comparisons by country are similar and lead to the conclusion that the pattern seen in 1969 is an unusual pattern, never previously observed, and not simply part of a long-term trend.

GEOGRAPHIC DISTRIBUTION

The extension of smallpox-free areas is another indication that 1969 could be the year of eradication. In 1963, all of the 19 countries in the Programme reported cases of smallpox, either officially or unofficially.

In 1967, 14 of the 19 countries reported smallpox; in 1968, 12 of the 19 countries reported smallpox; but, in April 1969, only 5 of the 19 countries were still reporting smallpox and only one of the five reported more than three cases.

In 15 months, between January 1968 and March 1969, both the geographic areas recording smallpox and the numbers of cases in these areas have declined (Figure 2). This is particularly dramatic when it is recalled that West Africa in the past three years has recorded some of the highest smallpox rates in the world (Table 1). In 1967 when the current vaccination programmes first began in West Africa, the five highest rates by country in the world were found in West Africa. Sierra Leone, for example, had a rate over four times as high as India.

THE SMALLPOX CASE

The age distribution of smallpox is dependent on the age group exposed and the immunity levels in that age group. In some areas of the world, smallpox is a disease of the pediatric age group: immunity resulting from past vaccination campaigns as well as from smallpox itself gradually increases with age, leaving relatively few susceptibles in the older age groups. While some outbreaks in West Africa have followed this pattern, the age distribution of smallpox cases in West and Central Africa follows very closely the age distribution of the population (Table 2). In particular, the 2,327 cases with known age, reported since January 1968, have shown an age distribution very close to the age distribution of the population as a whole. As smallpox in West and Central Africa is a disease of all age groups, the mass vaccination campaign must similarly be directed at all age groups.

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Table 3 compares smallpox mortality ratios by age groups in 1,118 patients from outbreak investigations in several countries and 1,090 cases reported from the Kano Infectious Diseases Hospital. In both groups, children under the age of one and persons over the age of 45 had the highest case fatality ratios. Both series, except for the under one age group, show similar age specific mortality ratios.

Among investigated cases, only 4% of patients under the age of 14 had a history of smallpox vaccination, but over the age of 45, over 50% gave a history of smallpox vaccination (Table 4). The percentage of cases who had a vaccination scar was considerably lower than the proportion who gave a history of vaccination. Among 124 cases under the age of 14 who were examined, 2 (1.6%) had scars, while among the entire group of examined cases only 6 of 185 (3.2%) had scars. The marked discrepancy between vaccination histories and presence of vaccination scars may be due to confusion in referring to other injections as "vaccinations", or it may reflect the known use of much impotent vaccine in the past.

SPEED OF TRANSMISSION OF SMALLPOX

One of the important observations in the present programme is that smallpox spreads with much more difficulty than previously appreciated. In table 5, several instances are cited in which over 50 days elapsed from the onset of symptoms in the first case in a compound to the onset of symptoms in the last case in the same compound even when only 4 or 5 susceptible persons resided there.

As many as 80 days have elapsed in a single compound between onsets of symptoms in the first and last cases when only 15 susceptible persons resided in the compound. A highly contagious disease would exhaust susceptibles much more rapidly.

Another indication of the difficulty which smallpox has in spreading is found in the susceptible exposure index. This rate relates cases of smallpox to number of exposures. If 100 persons were exposed to smallpox and one generation later all 100 persons developed smallpox, the rate would be 100 cases per 100 susceptible exposures. On the other hand, if 50 developed smallpox after one exposure and 50 more during the second generation of cases the total number of susceptible exposures would be 100 during the first generation and 50 during the second generation (50 already having developed the disease) or an overall total of 150 susceptible exposures among whom there were 100 cases - a rate of 100/150 or 66.7%. Examples cited in Table 5 show between 26 and 44 cases of smallpox per 100 susceptible exposures. For comparison, the rate would be approximately 80 cases per 100 susceptible exposures for measles. Smallpox is not a highly contagious disease but rather a disease which spreads with some difficulty.

Slow transmission allows smallpox to persist in a single compound for a long period while an increase in transmissibility would shorten the time which smallpox lingered in a given compound, it would also result in an increase in the number of compounds involved. Any increase in transmissibility would approach the measles situation and would make eradication more difficult. The finding of slow transmission is not only an indication of the inherent difficulty experienced by smallpox in maintaining itself, but it is also an asset to the Programme since it makes control of outbreaks feasible before they reach large proportions.

Summary:

- (1) The decrease in reported smallpox cases in West and Central Africa far exceeds that which would be expected from long-term trends and it is associated with a decrease in the geographic areas involved.
- (2) Some of the same countries reporting no smallpox in the past several weeks reported the highest rates in the world in 1967 and 1968.
- (3) The age distribution of smallpox in West Africa is similar to the age distribution of the population in West Africa.

- (4) Mortality rates are highest in the under 1 and the over 45 age group.
- (5) Vaccination scars are rarely seen in smallpox cases under 15 years of age.
- (6) Only 3.2% of smallpox cases examined had evidence of a past vaccination scar.
- (7) Smallpox spreads with great difficulty and this in turn is a definite asset in achieving eradication.

TABLE 1

World's 12 Highest smallpox incidence rates by country (per 100,000 population)
1966, 1967, 1968

<u>1966</u>		<u>1967</u>		<u>1968</u>	
<u>Rate</u>	<u>Country</u>	<u>Rate</u>	<u>Country</u>	<u>Rate</u>	<u>Country</u>
64.2	French Somaliland	68.3	<u>Sierra Leone</u>	45.4	<u>Sierra Leone</u>
35.4	<u>Niger</u>	40.2	<u>Guinea</u>	41.7	<u>Togo</u>
23.0	<u>Dahomey</u>	32.1	<u>Dahomey</u>	23.2	Congo, D.R.
13.1	<u>Sierra Leone</u>	31.7	<u>Niger</u>	18.2	<u>Niger</u>
13.0	Burundi	17.3	<u>Togo</u>	14.5	<u>Dahomey</u>
12.5	Congo. D.R.	15.3	India	13.3	Indonesia
12.4	<u>Togo</u>	13.4	Tanzania	9.9	Pakistan
11.1	Indonesia	11.7	Indonesia	8.6	<u>Guinea</u>
10.1	Swaziland	10.4	Pakistan	8.1	Burundi
8.7	<u>Nigeria</u>	9.0	Congo D.R.	4.8	India
8.0	Uganda	7.8	<u>Nigeria</u>	3.7	Tanzania
6.8	India	5.1	Brazil	3.7	Brazil

Countries of West and Central Africa are underlined.

TABLE 2

AGE DISTRIBUTION OF SMALLPOX
CASES IN WEST AND CENTRAL AFRICA⁽¹⁾

<u>January - December 1967</u>			
<u>Age</u>	<u>Number of Cases</u>	<u>Per Cent Distribution of Cases</u>	<u>Percentage Distribution of West African Population⁽²⁾</u>
< 1	23	1.5	4.3
1-4	299	19.6	14.5
5-14	413	27.0	25.1
15-44	678	44.4	42.0
45+	<u>115</u>	<u>7.5</u>	<u>14.0</u>
Total	1528	100.0	99.9
<u>January 1968 - February 1969</u>			
< 1	103	4.4	4.3
1-4	405	17.4	14.5
5-14	593	25.5	25.1
15-44	1006	43.2	42.0
45+	<u>220</u>	<u>9.5</u>	<u>14.0</u>
Total	2327	100.0	99.9

(1) Reported from investigations in Nigeria, Guinea, Togo, Cameroon, Dahomey, Mali, Niger, Ghana, Chad, Upper Volta, Sierra Leone.

(2) United Nations Demographic Yearbook.

TABLE 3

SMALLPOX MORTALITY BY AGE GROUP
WEST AND CENTRAL AFRICA

A. Outbreak Investigations Conducted in Cameroon, Dahomey, Ghana, Mali, Niger, Nigeria, Sierra Leone, and Togo.

<u>Age</u>	<u>Cases</u>	<u>Deaths</u>	<u>Case Fatality Ratio</u>
< 1	33	15	45.4
1-4	228	20	8.7
5-14	290	20	6.9
15-44	392	89	22.7
45+	<u>92</u>	<u>29</u>	<u>31.5</u>
TOTAL	1118	173	15.5

B. Kano IDH Hospital - 1,090 Consecutive Admissions - Reported 1968.

<u>Age</u>	<u>Cases</u>	<u>Deaths</u>	<u>Case Fatality Ratio</u>
< 1	69	15	21.7
1-4	189	28	14.8
5-14	204	18	8.8
15-44	319	64	20.1
45+	<u>11</u>	<u>4</u>	<u>36.4</u>
Total	1090	129	11.8

TABLE 4

VACCINATION STATUS OF SMALLPOX CASES

A. Vaccination Status by History of Investigated Smallpox Cases*

<u>Age</u>	<u>Number of Cases</u>	<u>History of Vaccination</u>	<u>Per Cent</u>
<1	30	1	3.3
1-4	179	5	2.8
5-14	255	11	4.3
15-44	158	41	25.9
45+	<u>17</u>	<u>10</u>	<u>58.8</u>
TOTAL	639	68	10.6

B. Vaccination Status by Examination for Scar of Investigated Smallpox Cases*

<u>Age</u>	<u>Number of Cases</u>	<u>Scar Present</u>	<u>Per Cent</u>
<1	3	0	0
1-4	46	0	0
5-14	75	2	2.7
15-44	60	4	6.7
45+	<u>1</u>	<u>0</u>	<u>0</u>
TOTAL	185	6	3.2

*From outbreak investigations in Cameroon, Dahomey, Ghana, Mali, Niger, Nigeria, Sierra Leone.

TABLE 5

EXAMPLES OF SLOW SMALLPOX TRANSMISSION
WITHIN A SINGLE COMPOUND

<u>Source</u>	<u>Contacts in Addition to Index Case</u>	<u>Contacts Without History of Vacc.</u>	<u>Interval Between Onset of Symptoms in Index Case and Onset of Symptoms in last Compound Case</u>
Nigeria (Abakaliki)	21	4	31 days
Nigeria (Abakaliki)	32	14	47 days
Nigeria (Abakaliki)	14	5	51 days
Cameroon (N'Game)	?	4	Approx. 53 days
Nigeria (Adepe-Ipiga)	30	27	Approx. 60 days
Nigeria (Gerere)	24	15	Approx. 80 days

Smallpox Cases as Related to Susceptible Exposures

<u>Source</u>	<u>Smallpox Cases</u>	<u>Susceptible Exposures</u>	<u>Cases per 100 Susceptible Exposure</u>
Nigeria (Abakaliki)	12	27	44.4
Cameroon (N'Game)	4	10	40.0
Nigeria (Gerere)	12	45	26.2

